IES
Newsletter

Volume 8, Number 6
November - December 1991

Director's Note

At this time of year, many see a visit to our greenhouse as a short holiday on a tropical island -- a warm, green respite from the colder, grayer surroundings. Many also come to learn about research in progress, as plant studies requiring controlled environmental conditions often are done in one or more of the building's seven units. Now, the greenhouse offers yet another dimension: since June, a program of integrated pest management is has been in use. Natural predators have replaced pesticides. The greenhouse ecosystem is becoming healthier each day.

Our cover story explains the use of integrated pest management in the greenhouse. Information for visitors is in the calendar on the back page. Come enjoy a tropical holiday, at any time of year.

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the Editor.

Gene E. Likens, Director
Joseph S. Warner, Administrator
Alan R. Berkowitz, Head of Education

Editor: Jill Cadwallader
Printing: Central Press

INSTITUTE OF ECOSYSTEM STUDIES
The New York Botanical Garden
Mary Flagler Cary Arboretum
Education Program
Box R
Millbrook, NY 12545-0178
(914) 677-5359

The End of an Era in the Greenhouse

Mealybugs. Aphids. Spider mites. Thrips. Whiteflies. These destructive insects are the scourge of greenhouse managers and houseplant fanciers alike. Since the Institute greenhouse opened in 1972, such insect pests had been controlled by monthly pesticide spraying and/or fumigation -- twice a month during the summer. All this ended, however, in June 1991 when four predatory insect species were introduced to the facility as biological control agents. These creatures didn't suck plant juices and injure plants -- instead, they were hungry for juicy mealybugs, spider mites, aphids and thrips. They were the tangible evidence of the Institute's leap into the world of integrated pest management.

Integrated pest management (IPM) is a multi-disciplinary approach in which pests are controlled by biological control agents, such as parasites, predators or disease organisms, in conjunction with other management techniques that reduce the likelihood of insect pest outbreaks. The practice of biological control is not new: over two thousand years ago the Chinese kept ants in citrus trees to eat caterpillars and boring beetles that attacked the trees. Not long after that the Chinese began using spiders for similar purposes. More recently, in 1752, Carolus Linnæus, the Swedish botanist who established the classification system for plants and animals that is still used by taxonomists today, advised that predatory insects should be used to control pests on crop plants.

David Bulkeley, manager of the Institute's greenhouse, had been using pesticides for all of his 16 years there. Each time spraying was to be done he would lock the door to visitors, dress in protective clothing, then spend the next hour and a half applying one of the six chemicals that he used in rotation to prevent mealybugs and other pests from building up a resistance. In spite of regular treatment, however, those mealybugs were still enjoying *Hoya* plants, aphids were attacking *Hibiscus* shrubs and spider mites were besieging banana trees.

Mr. Bulkeley had had ecological concerns about pesticide use for some time, but was hesitant to abandon this proven technique for something totally new. Once the decision was made to use biological controls, there would be no turning back: any pesticide application would kill the predators along with the pests. Then, in early 1991, several things happened. Dr. Vera Krischik (see IES NEWSLETTER Vol. 8 No. 2) began two years of research at the Institute studying relationships between insects and plants. Earlier in her career she had been a science administrator with the U.S. Department of Agriculture, and during her tenure had instituted IPM practices for grain and food storage. Mr. Bulkeley took advantage of her expertise as he investigated the pros and cons of biological control. Also, a number of students in the Research Experiences for Undergraduates program were using the greenhouse around the clock for their projects, so spraying was out of the question. Thus, when he saw an 800-number for a biological pest control firm in Colorado, he was ready to make the call.

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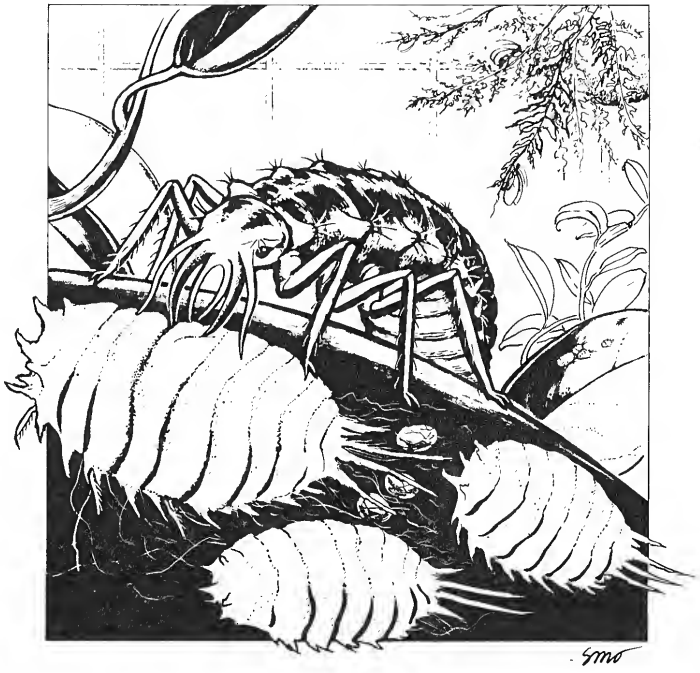


IPM at work in the Institute's greenhouse: Mealybugs, sucking the juices of Hoya *leaves in the foreground and center right, are defenseless against attack by larvae of the green lacewing. The delicate, winged lacewing adults, three of which are in the fern at the upper right of the drawing, live for approximately 30 days, eating pollen, nectar and honeydew and laying from 20-30 eggs a day. The eggs hatch into larvae, and the predator vs. prey cycle in the greenhouse continues.*

Drawing by
Sharon Machida Okada

Greenhouse, *continued from page 1*

The first shipment of predatory insects arrived in August, in small jars, by overnight mail. There were 6,000 eggs of the green lacewing *Chrysopa carnea* and 250 adult *Cryptolaemus montrouzieri* -- Australian lady beetles known among IPM users as "mealybug destroyers." There were also 2,000 *Amblyseius cucumeris*, predatory mites that eat thrips and when the thrips are gone will eat spider mites. (They can also live on pollen, thereby surviving in the greenhouse ecosystem until their insect prey is reintroduced.) And, with a specific taste for spider mites, there was another species of predatory mite called *Phytoseiulus persimilis*. The contents of the jars were sprinkled in areas where pest infestation was highest. Because there was pesticide residue everywhere, including in the pests' bodies, a number of the newcomers died after eating their first meals. An equally large number escaped through the greenhouse vents, which are often left open in the summer.

More shipments followed, however, and positive effects were noticed quickly. The larval lacewings were particularly effective: these 3 mm long (1/8 inch) creatures have long, curved jaws with which they quickly dispatch and devour mealybugs, aphids and red spiders. Mr. Bulkeley likens them to "little vacuum cleaners." After a short time, the greenhouse was receiving regular shipments of lacewing eggs only, and calling in orders for the other insects just when needed.

As mentioned, IPM requires the use of other management techniques in conjunction with the biological controls. Mr. Bulkeley, his assistant Becky Dolfinger and the greenhouse volunteers must do regular maintenance by cutting away damaged leaves, using alcohol and insecticidal soap (potassium salts of fatty acids) to treat localized pest infestations, and taking care during propagation to use only clean, healthy plants. These routine procedures may be time-consuming, but the results make them all worthwhile.

Mr. Bulkeley reports a notable improvement in the health and appearance of the plants since June, when spraying stopped. Plants that had been infested at the start of summer are flourishing; a prime example is the ponderosa lemon ... a favorite of greenhouse visitors, and, before IPM, of mealybugs. An additional benefit is that all the plants -- even those that had not been affected seriously by pests -- are looking better now that their leaves are free from dulling pesticide residues.

There is no thought of turning back: lacewings and other beneficial predators are now permanent constituents of the IES greenhouse ecosystem. Visitors may be able to spot some of these tiny insects, with a bit of luck and a large measure of careful observation. Otherwise, Mr. Bulkeley has offered his services: the curious should feel free to ask him about recent sightings.

IES Workshop for UNEP Fellows

A workshop structured to highlight the interface between basic ecological research and environmental problems was held at the Institute in November. The participants were 15 United Nations Environmental Programme (UNEP) Fellows, leading environmental managers and researchers from developing nations, who spent a semester at Tufts University (Medford, Massachusetts) studying ecosystem management.

The workshop, organized by IES head of education Dr. Alan R. Berkowitz, featured lectures by Institute ecologists whose expertise is in the fields of terrestrial and aquatic ecosystems. Dr. Gene E. Likens, Institute director and co-founder of the 29-year Hubbard Brook Ecosystem Study, introduced the program with a discussion of long-term ecosystem research. Field trips to Tivoli Bays on the Hudson River and to the IES air quality monitoring station complemented the lectures.

Representing three Latin American, seven African and four Asian nations, the UNEP Fellows were selected for participation by their governments. The director of the UNEP/Tufts Program is Dr. Richard E. Wetzler, adjunct associate professor at the Center for Environmental Management at Tufts. An ecologist, Dr. Wetzler is dedicated to helping environmental managers in developing nations use the most current knowledge from the field of ecology in their work. To help accomplish his goal, he enlisted the help of IES scientists and educators in the fall 1990 UNEP Fellows Program. The strongly positive response by both Fellows and IES staff led to his including the Institute in the 1991 program as well.


TOM TAFT

UNEP Fellows from 14 countries participated in an ecosystem science workshop at IES. The UNEP/Tufts Program director, Dr. Richard Wetzler, is standing, third from the right.

IES Notes

• Holiday spirit at the Institute included a return to the Lunch Box* to provide a holiday meal for 230 residents of Poughkeepsie, N.Y. Graduate student Rich Pouyat and research assistant Lane Smith raised money from IES co-workers to buy food, and, with the remaining funds, a gift for each child. Then on Sunday, Dec. 22, they organized a dozen of their colleagues to prepare and serve turkey soup, ham sandwiches, ice cream, cookies ... and a candy cane. For one of the helpers, Dr. Dolors Vaqué, the event was also a special kind of farewell party, as the following day she was returning to the Institute of Marine Sciences, Barcelona, Spain, after two years of post-doctoral study at the Institute.

* *The Lunch Box is a service of Dutchess Outreach, a United Way Agency.*

New Address

The IES Education Program has a new mailing address:

Institute of Ecosystem Studies
Mary Flagler Cary Arboretum
Education Program
Box R
Millbrook, New York 12545-0178

Correspondence to Education Program staff as well as that dealing with ecology education, visitor activities, the Continuing Education Program, the Volunteer Program and the IES NEWSLETTER should be sent to this address.

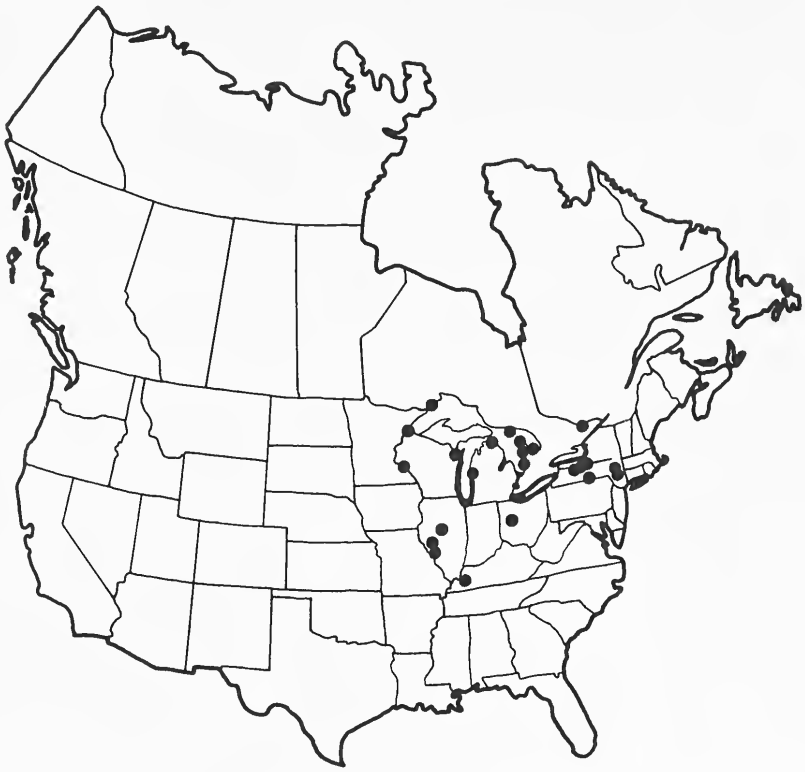
Zebra Mussel Update

Introduced into the Great Lakes only seven years ago, the zebra mussel now has spread to freshwater bodies in eight states and two Canadian provinces. An inevitable extension of the animal's range was the Hudson River, and in May 1991 the first zebra mussel was found by two part-time commercial fishermen near Catskill, N.Y. Then, in August, IES ecologist Dr. David Strayer and his assistant Lane Smith found the first one at Poughkeepsie.

The European freshwater zebra mussel, *Dreissena polymorpha*, has been expanding through the rivers of Europe since the 18th century. In 1985 a ship from a freshwater port in Europe discharged its ballast water in Lake St. Clair in the Great Lakes ... and the zebra mussel had arrived in North America. One reason for the rapid spread of the population of these mollusks, or shellfish, is the way that they passively take advantage of ship traffic, traveling as chance passengers in ballast, on hulls or in cargoes. Another reason is that they are extremely prolific: they spawn throughout the summer, and during the peak of their reproductive cycle there may be as many as 100 of the 0.1 mm (1/250 of an inch)-long larvae per liter (approximately a quart) of water. After spending a short time as plankton, these larvae anchor themselves to a hard substrate -- rope or netting, stones or sticks, boat hulls or anchors -- then metamorphose and take on the appearance of miniature adult mussels complete with the characteristic black stripes on the shell. They live for four to six years, growing to 3.8-5.0 cm (1.5-2 in.) in shell length.

Dr. Strayer reports that the average density in the Hudson River now is about 50 zebra mussels per square meter (approximately a square yard) of substrate. He estimates that within a year there could be as much as a 1000-fold increase, and that in two-to-three years there will be from 1,000-10,000 adult mussels per square meter. In a November 1991 talk at the annual meeting of the Hudson River Environmental Society, Dr. Strayer extended his prediction to five years, saying that by then there could be as many as 150 billion zebra mussels in the river's tidal region. The populations will reach only as far south as the West Point area, where the animals will be stopped by greater salt concentrations in the water.

With funding from the Hudson River Foundation, Dr. Strayer has been surveying the benthic, or bottom-living, animal communities of the Hudson River for the past two years. In addition, scientific colleagues at the Institute are doing long-term studies of the river that include bacterial and planktonic populations, water chemistry and water transparency. Impacts of the invading shellfish now can be measured against these baseline biological, chemical and physical data.



In 1985, the zebra mussel was introduced to Lake St. Clair in the Great Lakes in ballast water discharged by a European cargo ship. Zebra mussel larvae spread rapidly to Lakes Erie, Ontario and Michigan, and to the St. Lawrence Seaway. By late 1991, the shellfish had become established in freshwater bodies in eight states and two Canadian provinces.
Map by David L. Strayer

The direct effects of zebra mussel invasions are well documented. As they attach themselves to the inner walls of water intake pipes, they can slow or eventually stop the flow to users of river water. Boat owners may notice that their crafts are slower, as animals attach themselves to the hulls, or that the outboard motor cooling systems become clogged. Zebra mussels feed by filtering phytoplankton, bacteria and small particles of organic debris from water that passes through their bodies, so when populations are large enough they have a noticeable effect on the transparency of the water. River watchers, therefore, may notice the water becoming less murky.

Indirect effects have yet to be documented. Using the existing baseline data, Dr. Strayer and his colleagues will monitor changes in the Hudson River ecosystem. Aquatic weeds such as water celery, common now in shallow parts of the river, may expand their ranges into deeper water as increasing clarity allows more light to reach the bottom. Animals that eat shellfish, such as sturgeon and some species of diving ducks, may increase in number. Other, unanticipated changes remain to be seen.

Methods developed in Europe to prevent fouling already are being applied in the United States in places where zebra mussels are established. Beginning several years ago, local companies began planning for the Hudson River invasion, and consultants and divers have suggested a variety of solutions: chlorine, high-power water jets, scouring. Different pipe coatings currently are being tested.

As soon as the zebra mussel was introduced in North America, its spread was inevitable. Natural controls for exotic species rarely exist, so when such species are introduced by individuals or through commerce they establish themselves rapidly. The way to prevent the invasion of exotic species is through education and legislation ... the introduction of the zebra mussel prompted some action, but more serious measures must be taken before the potential for serious problems is reduced significantly.

Winter Calendar

CONTINUING EDUCATION PROGRAM

Among the **winter semester**'s offerings are some special half-day and one-day programs:

Feb. 15: Workshop: **Bringing Out the Best in Shrubs**
Feb. 19: **All About Annuals**
Mar. 11: Workshop: **Particular Plants for Particular Places**
Mar. 16: Excursion: **New York Flower Show**
Mar. 18: **Garden Design with Foliage**
Mar. 21: **Basic Cultural Techniques for Perennials**
Mar. 26: **Spring Wildflower Gardening**
Mar. 28: Workshop: **Landscaping with Perennials the Organic Way**
• *Catalogues with all the winter and spring classes, workshops and excursions are available at the Gifford House.*

SUNDAY ECOLOGY PROGRAMS

Free public programs are held on the first and third Sunday of each month, except over holiday weekends. Programs begin at 2 p.m. at the Gifford House on Route 44A unless otherwise noted*. Call (914) 677-5359 to confirm the day's topic.

Mar. 8 (note date): **Maple Sugar Ecology for Kids**, a walk and demonstration led by Diana Wilson. *Note: Kids must be accompanied by an adult. There is a maximum of 30 participants for this program, and advance reservations are required. Call Susan Eberth weekdays after Feb. 17, at the number below.*
Mar. 15: **A Simple Sample: Ecosystem Science from Start to Finish**, a talk and tour of the laboratories led by Kathleen Weathers. (* Meet at the Plant Science Building for this program.)

Sunday Programs, continued:

Apr. 5: **Which Came First: the Flower? ... or the Pollen?**, a slide presentation by Dr. Steward Pickett.
• *For outdoor programs, dress according to the weather. Waterproof boots are suggested. In case of inclement weather, call (914) 677-5358 after 1 p.m. to learn the status of the day's program.*

IES SEMINARS

The Institute's program of **scientific seminars** features presentations by visiting scientists. Free seminars are held at the Plant Science Building on Fridays at 3:30 p.m.

Feb. 14: Topic: **Social organization in horses, zebras and asses**, by Dr. Daniel Rubenstein, Princeton University.
Feb. 21: **Regulation of Stream Water Chemistry: A Matter of Rocks, Soils and Bugs**, by Dr. Patrick Mulholland, Oak Ridge National Laboratory.
Feb. 28: **Habitat Fragmentation and Plant-Animal Interactions on the 'Chaco Cerrano' of Northwestern Argentina**, by Dr. Peter Feinsinger, University of Florida.
Mar. 6: Topic: **Brown Tides**, by Dr. Elizabeth Cosper, SUNY at Stony Brook.
Mar. 13: **Phytoplankton Limitation by Silica**, by Dr. D. Conley, Horn Point, Chesapeake Bay.
Mar. 20: **Cladocera in the Littoral Zone: Short- and Long-term Dynamics**, by Dr. Michael Paterson, Freshwater Institute, Canadian Department of Fisheries and Oceans.
Mar. 27: **Impact of Acidification on Zooplankton in Ontario Lakes**, by Dr. Norman Yan, Ontario Ministry of the Environment.
• *Call (914) 677-5343 to confirm the day's seminar topic.*

GREENHOUSE

The IES greenhouse is a year-round tropical plant paradise as well as a site for controlled environmental research. The greenhouse is open during Arboretum hours. Admission is by free permit from the Gifford House.

GIFT SHOP

Senior Citizens Days: On Wednesdays senior citizens receive a 10% discount on all purchases (except sale items).

ARBORETUM HOURS

Winter hours are in effect from October 1 - April 30.
The Arboretum is closed on public holidays.

Arboretum grounds are open Mon. - Sat., 9 a.m. to 4 p.m.; Sun. 1 - 4 p.m. Internal roads and trails are closed when snow-covered.
The **Gift and Plant Shop** is open Tues. - Sat., 11 a.m. to 4 p.m. and Sun. 1 - 4 p.m. (closed weekdays from 1 - 1:30 p.m.).
• *All visitors must obtain a free permit at the Gifford House for access to the Arboretum. Permits are available until 3:00 p.m. daily.*

MEMBERSHIP

Become a member of the Mary Flagler Cary Arboretum. Benefits include a member's rate for IES courses and excursions, a 10% discount on purchases from the Gift Shop, a free subscription to the IES NEWSLETTER, and parking privileges and free admission to the Enid A. Haupt Conservatory at The New York Botanical Garden in the Bronx. Individual membership is $30; family membership is $40. For information on memberships, contact Janice Claiborne at (914) 677-5343.

For more information, call (914) 677-5359 weekdays from 8:30 - 4:30.

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